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10/551,834	10/17/2006	Gary T. Rochelle	UTSB:719US/10510215	4223
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EXAMINER MCKENZIE, THOMAS B				
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/551,834

Applicant(s)

ROCHELLE ET AL.

Examiner

THOMAS BENNETT MCKENZIE

Art Unit

1797

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-42 is/are pending in the application.
- 4a) Of the above claim(s) 11-16 is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-10 and 17-42 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. ____.
 - ☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO/SB/CD)
Paper No(s)/Mail Date 01/26/2010
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date ____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: ____

DETAILED ACTION

Response to Arguments

1. Applicant's arguments, see Arguments/Remarks, filed 01/26/2010, with respect to the rejection(s) of **claim(s) 1-10 and 17-42** under 35 USC 102(b) and 35 USC 103(a) have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of the following prior art.

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

3. **Claims 1-4, 6-22, 24-30, 32-39 and 41-42** are rejected under 35 U.S.C. 103(a) as being unpatentable over Grossmann et al, USP 6,436,174 (Grossmann).

4. Regarding **claim 1**, Grossmann substantially teaches a method of removing carbon dioxide from a gaseous stream (column 1, lines 1-5) comprising: contacting a gaseous stream with a solution (column 4, lines 65-68), the solution being formed by combining at least:
 5. a primary or secondary polyamine ("piperazine", column 2, lines 45-50) having an amine concentration of 0.1 to 50 weight percent (column 2, lines 35-40) which substantially reads on the claimed value of at least 3.0 equivalents/Kg water, wherein the amines located on the polyamine are not sterically hindered ("piperazine", column 2, lines 45-50)
 6. an alkali salt (column 2, lines 10-15) having a concentration of up to 35 weight percent (column 3, lines 40-45) which substantially reads on the claimed value of at least 1.0 equivalents/Kg water, and water (column 2, lines 5-10);
 7. whereby contacting removes carbon dioxide from the gaseous stream (column 1, lines 1-5); and regenerating the solution (column 5, lines 35-40).
8. Regarding **claim 17**, Grossmann substantially teaches a method of removing carbon dioxide from a gaseous stream (column 1, lines 1-5) comprising: contacting a gaseous stream with a solution (column 4, lines 65-68), the solution being formed by combining at least:
 9. a primary or secondary polyamine("piperazine", column 2, lines 45-50) having an amine concentration of 0.1 to 50 weight percent (column 2, lines 35-40) which substantially reads on the claimed value of at least 5.1 equivalents/Kg water, wherein

the amines located on the polyamine are not sterically hindered ("piperazine", column 2, lines 45-50),

10. an alkali salt (column 2, lines 10-15) having a concentration of up to 35 weight percent (column 3, lines 40-45) which substantially reads on the claimed value of at least 5.1 equivalents/Kg water, and water (column 2, lines 5-10);

11. whereby contacting removes carbon dioxide from the gaseous stream (column 1, lines 1-5); and regenerating the solution (column 5, lines 35-40).

12. Regarding **claim 18**, Grossmann substantially teaches the concentration of the polyamine and the concentration of the alkali salt are from 0.1 to 50 weight percent (column 2, lines 35-40) and up to 35 weight percent (column 3, lines 40-45), respectively, which substantially reads on the value of at least 2.3 m.

13. Regarding **claim 19**, Grossmann substantially teaches the concentration of the polyamine and the concentration of the alkali salt are from 0.1 to 50 weight percent (column 2, lines 35-40) and up to 35 weight percent (column 3, lines 40-45). Thereby it is possible to have the polyamine and alkali salt at equal concentrations.

14. Regarding **claim 36**, Grossmann substantially teaches A method of removing carbon dioxide from a gaseous stream (column 1, lines 1-5) comprising: contacting a gaseous stream with a solution (column 4, lines 65-68), the solution being formed by combining at least:

15. a piperazine derivative (column 2, lines 45-55) having an amine concentration of 0.1 to 50 weight percent (column 2, lines 35-40) which substantially reads on the

claimed value of 3.0-10.0 equivalents/Kg water, wherein the amines located on the piperazine derivative are not sterically hindered (column 2, lines 45-55)

16. an alkali salt having a concentration of up to 35 weight percent (column 3, lines 40-45) which substantially reads on the claimed value of 3.0-10.0 equivalents/Kg water and water (column 2, lines 5-10);

17. wherein the concentration of the piperazine derivative and the concentration of the alkali salt are approximately equal (this is possible for the same reasons stated in **claim 19** above); and

18. whereby contacting removes carbon dioxide from the gaseous stream (column 1, lines 1-5); and regenerating the solution (column 5, lines 35-40).

19. Regarding **claim 37**, Grossmann substantially teaches the piperazine derivative is piperazine (column 2, lines 45-55) which reads on the claimed range consisting of: piperazine, aminoethylpiperazine or hydroxyethylpiperazine.

20. Regarding **claims 2 or 20**, Grossmann substantially teaches the polyamine is piperazine (column 2, lines 45-50) which reads on the group consisting of: piperazine, aminoethylpiperazine, hydroxyethylpiperazine, ethylenediamine, dimethyl ethylenediamine.

21. Regarding **claims 3, 21 or 38**, Grossmann substantially teaches the alkali salt is potassium carbonate (column 3, lines 40-45) which reads on the claimed group consisting of: potassium carbonate, sodium carbonate, lithium carbonate, a bicarbonate salt, a bisulfide salt or a hydroxide salt.

22. Regarding **claims 4, 22, or 39**, Grossmann substantially teaches the gaseous stream is contacted with the solution at a temperature of approximately 40 to 100°C (column 5, lines 15-25) which reads on the claimed range of 25 to 120°C.

23. Regarding **claims 6, 24 or 41**, Grossmann substantially teaches the solution further comprises an additive (column 3, lines 45-50).

24. Regarding **claim 7**, Grossmann substantially teaches the polyamine concentration and the alkali salt concentration are from 0.1 to 50 weight percent (column 2, lines 35-40) and up to 35 weight percent (column 3, lines 40-45), respectively, which substantially reads on the value of at least 2.3 m.

25. Regarding **claim 8**, Grossmann substantially teaches the polyamine concentration is from 0.1 to 50 weight percent (column 2, lines 35-40) and the alkali salt is up to 35 weight percent (column 3, lines 40-45) which substantially reads on the ratio of equivalents of alkali salt to equivalents of polyamine is 0.3-3.0.

26. Regarding **claim 9**, Grossmann substantially teaches a water wash system, wherein the water wash system collects the polyamine from treated gaseous stream (column 6, lines 1-5).

27. Regarding **claims 10, 25, or 42**, Grossmann substantially teaches the limitations of **claim 1** as described above. Note that Grossmann does not explicitly teach the rate for the solvent-mediated removal of carbon dioxide from the gaseous stream is at least 1.5 times the rate for carbon dioxide removal in a method using an aqueous solution of 5.0-M monoethanolamine. However, Grossmann does teach that the absorption solution used can increase the absorption rate of carbon dioxide by up to a factor of 90

over an absorption solution that contains MDEA instead of piperazine (column 4, lines 35-45). Note that even though MDEA is different from monoethanolamine, it would have been obvious to one of ordinary skill in the art for piperazine to show improvement over monoethanolamine. Additionally, since the components of Grossmann are substantially the same as the Applicant's, it would have been obvious to one of ordinary skill in the art at the time of the invention for Grossmann's method to produce the same results as the Applicant's.

28. **Claim 5, 23 and 40** are rejected under 35 U.S.C. 103(a) as being unpatentable over Grossmann in view of in view of "Absorption of carbon dioxide into aqueous piperazine: reaction kinetics, mass transfer and solubility", Sanjay Bishnoi and Gary Rochelle, Chemical Engineering Science, volume 55, issue 22, November 2000, pp. 5531-5543, hereafter referred to as Bishnoi.

29. Regarding **claims 5, 23 and 40**, Grossman substantially teaches the limitations of **claims 1, 17 or 36** as described above. Note that Grossman does not teach the rate constant for the reaction of carbon dioxide with the piperazine derivative (K_{PZ}) is at least $25 \text{ m}^3 / \text{mol} - \text{s}$ at 25°C .

30. In an analogous art of absorbing carbon dioxide, Bishnoi substantially teaches the rate constant for the reaction of carbon dioxide with piperazine is 53,700 $\text{m}^3 / \text{kmol} - \text{s}$ at 25°C which reads on the claimed range of at least $25 \text{ m}^3 / \text{mol} - \text{s}$ at 25°C , for the benefit of absorbing carbon dioxide. It would have been obvious to one of ordinary skill in the art at the time of the invention to combine the method described in Sartori with piperazine described in Bishnoi for the benefit of absorbing carbon dioxide.

31. **Claims 26-31 and 33-35** are rejected under 35 U.S.C. 103(a) as being unpatentable over Ijima et al, USP 5,853,680 (Ijima).
32. Regarding **claim 26**, Ijima substantially teaches a method of removing carbon dioxide from a gaseous stream comprising: contacting a gaseous stream with a solution (column 1, lines 5-10), the solution being formed by combining at least:
33. a primary or secondary polyamine ("piperazine", column 3, lines 15-20) wherein the amines located on the polyamine are not sterically hindered ("piperazine", column 3, lines 15-20),
34. an alkali salt ("potassium carbonate", column 3, lines 15-20) and water ("aqueous", column 3, lines 15-20),
35. wherein the solution contains less than 1% of a monohydric or polyhydric alcohol (column 3, lines 15-20).
36. Note that although Ijima does teach that an alcohol can be used as the absorbing solution (column 3, lines 15-20), it would have been obvious to one of ordinary skill in the art at the time of the invention to use potassium carbonate with piperazine as the absorbing solution, as evidenced by claim 4 of Ijima.
37. Note also that Ijima does not teach an amine concentration of 3.0 equivalents/Kg water or an alkali salt having a concentration of at least 1.0 equivalents/Kg water. However, it would have been obvious to one of ordinary skill in the art at the time of the invention to adjust these concentrations in order to optimize performance.
38. Regarding **claim 27**, Ijima substantially teaches no alcohol is added to the solution (column 3, lines 15-20 and claim 4).

39. Regarding **claim 28**, Ijima substantially teaches the polyamine is piperazine (column 3, lines 15-20) which reads on the claimed group: piperazine, aminoethylpiperazine, hydroxyethylpiperazine, ethylenediamine, dimethyl ethylenediamine.

40. Regarding **claim 29**, Ijima substantially teaches the alkali salt is potassium carbonate (column 3, lines 15-20) which reads on the claimed group of: potassium carbonate, sodium carbonate, lithium carbonate, bicarbonate salt, a bisulfide salt, or a hydroxide salt.

41. Regarding **claim 30**, Ijima does not explicitly teach the gaseous stream is contacted with the solution at a temperature of approximately 25-120°C. However, Ijima does teach the difference in saturated carbon dioxide absorption level between 40 and 120°C is "employed as an index to the ability of an absorbing fluid to absorb carbon dioxide in the absorption step and liberate carbon dioxide when heated in the regeneration step" (column 2, lines 55-68). Since this temperature range is used as a standard for the absorption fluid, it would have been obvious to one of ordinary skill in the art at the time of the invention to perform the method within this range.

42. Regarding **claims 31 and 35**, Ijima does not explicitly teach the rate constant for the reaction of carbon dioxide with the piperazine derivative or the rate of solvent-mediated removal of carbon dioxide from the gaseous stream. However, it would have been obvious to one of ordinary skill in the art at the time of the invention for the rate constant and rate to conform with these values since the composition used in Ijima is substantially the same as the Applicant's (see MPEP 2112.91, I).

43. Regarding **claims 33 and 34**, Ijima does not explicitly teach the polyamine and salt concentrations are 2.3 m or the ratio of equivalents of alkali salt to equivalents of polyamine. However, it would have been obvious to one of ordinary skill in the art at the time of the invention to adjust these concentrations to optimize performance.

44. **Claim 32** is rejected under 35 U.S.C. 103(a) as being unpatentable over Ijima in view of Grossmann.

45. Regarding **claim 32**, Ijima substantially teaches the limitations of **claim 26** as described above. Note that Ijima does not explicitly teach using an additive. However, Ijima does teach that the method is carried out in absorption towers (column 3, lines 45-50).

46. In an analogous art of using an absorbing solution to remove carbon dioxide from a gas stream, Grossmann substantially teaches using an additive for the benefit of preventing corrosion (column 3, lines 45-55). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to use the additive of Grossmann with the method of Ijima to prevent corrosion.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within

TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to THOMAS BENNETT MCKENZIE whose telephone number is (571) 270-5327. The examiner can normally be reached on Monday-Thursday 7:30AM-5:00PM Alt. Friday 7:30AM-4:00PM EST..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, DUANE SMITH can be reached on (571) 272-1166. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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Supervisory Patent Examiner, Art
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